HHS Public Access

Author manuscript

Circulation. Author manuscript; available in PMC 2016 November 10.

Published in final edited form as:

Circulation. 2016 May 10; 133(19): 1861–1866. doi:10.1161/CIRCULATIONAHA.115.020536.

Menthol and Non-menthol Cigarette Smoking: All-cause, Cardiovascular Disease and Other Causes of Death among Blacks and Whites

Heather M. Munro, MS[1], **Robert E. Tarone, PhD**[1], **Thomas J. Wang, MD**[2], and **William J. Blot, PhD**[1,2]

[1]International Epidemiology Institute, Rockville, MD

[2]Department of Medicine, Vanderbilt University Medical Center (VUMC), Nashville, TN

Abstract

Background—In contrast to whites, African American smokers prefer menthol cigarettes over non-menthol cigarettes by a large margin and also tend to have higher mortality from several smoking-related diseases than whites, raising the possibility that menthol cigarettes contribute to racial disparities in risk. Evidence regarding differential associations between menthol vs. non-menthol cigarettes indicates lower cancer risk for menthol smokers, but for cardiovascular disease (CVD) mortality evidence has been inconsistent.

Methods and Results—Cox proportional hazards models were used to compute hazard ratios (HRs) and accompanying 95% confidence intervals (CIs) for all-cause and CVD mortality for menthol compared to non-menthol cigarette smokers among 65 600 participants in the Southern Community Cohort Study, an ongoing community-based cohort with the largest number of menthol smokers being traced. Among the 27 619 current cigarette smokers, 4224 died during follow-up with 1130 deaths attributed to CVD. Both all-cause (HR = 0.93, 95% CI = 0.86 to 1.01, p = 0.10) and CVD (HR = 0.88, 95% CI = 0.76 to 1.03, p = 0.10) mortality risks were similar in menthol compared to non-menthol cigarette smokers.

Conclusions—Smoking regardless of cigarette type is hazardous to health, but these results do not indicate that menthol cigarettes are associated with greater CVD risks than non-menthol cigarettes.

Keywords

Cardiovascular disease; Mortality; Smoking; Epidemiology

Menthol is a chemical compound with mild local anesthetic qualities and a mint scent that is added to some cigarettes. Smokers have reported that they experienced easier and deeper inhalation and less irritation in the throat while smoking menthol cigarettes.[1] It has been

Address correspondence to authors at: Dr. William J. Blot, International Epidemiology Institute, 1455 Research Blvd., Suite 550, Rockville, MD 20850, Tel: 301 424 1054; Fax: 301 424 1053, ; Email: blotw@iei.us

Conflict of Interest Disclosures

None

suggested that mentholation may affect cigarette smoking behaviors such as initiation, inhalation, dependency, and cessation.[2] Menthol cigarette smoking is much more prevalent among African American smokers than white smokers and in recent years (2004–2010), menthol cigarette use has remained stable in adults while non-menthol cigarette use has declined.[3,4] African Americans experience higher incidence and mortality from several smoking-related diseases, including cardiovascular disease (CVD) and stroke,[5] but whether menthol cigarette smoking contributes to these differentials is not clear with inconsistent evidence from the few studies[6–8] that have examined risks of these illnesses in menthol vs non-menthol smokers. The issue is topical since the U.S. Food and Drug Administration (FDA) has been deliberating regulation of menthol cigarettes since the Tobacco Control Act, a law banning the use of all flavoring except menthol in cigarettes, was passed in 2009. The Southern Community Cohort Study (SCCS), with its large number of African American smokers, affords the unique opportunity to assess the effects of menthol cigarette use on smoking-related mortality.

Methods

Study Design and Participants

The SCCS is an ongoing prospective cohort study designed to investigate health disparities between African Americans and Whites in underserved populations in the following 12 Southeastern states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.[9,10] Over 85 000 adults, two-thirds African American, between the ages of 40 and 79 were enrolled from 2002–2009 either in person at one of 71 community health centers (CHC, ~85%) or by mailings to stratified random samples of the general populations (GP) of these states. Participants completed a questionnaire, via personal interview at CHCs, with detailed information on demographic, socioeconomic, and anthropometric characteristics, personal and family medical history, and lifestyle choices such as tobacco and alcohol use and diet. Vital status was ascertained through direct contact with participants and linkages with the National Death Index (NDI) and the Social Security Administration's Service for Epidemiologic Research. For analyses of all-cause mortality and cause-specific mortality, follow-up ended at the date of death, date lost to follow-up, or December 31, 2013 (the latest date for which cause of death was available from NDI). The study was approved by the institutional review boards of Vanderbilt University and the Meharry Medical College and participants gave written informed consent at study enrollment.

Participants were asked whether they had smoked at least 100 cigarettes in their entire lifetime and if they had, whether they still smoked at the time of enrollment in the study. They were also asked the average number of cigarettes they smoke (or used to smoke) in one day and whether the cigarettes were usually menthol. Our primary variable of interest, smoking status at cohort entry, was defined as never smoker (reference), former smoker of menthol cigarettes, former smoker of non-menthol cigarettes, current smoker of <10 menthol cigarettes per day (cpd), current smoker of <10 non-menthol cpd, current smoker of 10–19 menthol cpd, current smoker of 10–19 non-menthol cpd, current smoker of ≥20 menthol cpd, and current smoker of ≥20 non-menthol cpd. Data on age at enrollment, age of

smoking initiation, and age at cessation (for former smokers) were available to calculate smoking duration. Pack-years of smoking were calculated by dividing the number of cigarettes smoked per day by 20 to determine the number of packs per day and then multiplying by smoking duration in years.

Beginning with 84 563 active participants, those who reported a race other than African American (black) or white (N=4126), had data determined to be unreliable (N=804), reported having had cancer other than non-melanoma skin cancer or a history of myocardial infarction or coronary artery bypass surgery at baseline (N=11 248), were missing information on the covariates included in the models (N=2592), were missing cause of death for those who died (N=177), or who had the same age in months at enrollment and at the end of follow-up resulting in 0 months of follow-up time (N=16), were excluded from the cohort resulting in 65 600 participants available for the analyses. Persons reporting chronic obstructive pulmonary disease were also excluded in sensitivity analyses, but they were retained in the final models since the exclusion resulted in little differences in the risk estimates.

Statistical Analysis

Pearson's chi-square, analysis of variance (ANOVA), and Kruskal-Wallis tests were performed to assess differences between race, sex, or race-sex groups for variables included in the analyses. Cox proportional hazards models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for mortality from all causes of death (N=7689), cardiovascular disease (N=2289; ICD-10 codes I00–I78), heart disease (N=1687; ICD-10 codes I00–I09, I11, I13, I20–I51) and stroke (N=389; ICD-10 codes I60–I69), as the underlying cause of death among SCCS participants after enrollment in the cohort. In addition, for comparative purposes, we also computed HRs for cancer (N=1875; ICD-10 codes C00–C97), lung cancer (N=649; ICD-10 code C34), all types of cancer except lung cancer (N=1226; ICD-10 codes C00–C33, C35–C97), and non-asthma chronic obstructive pulmonary disease (COPD; N=313; ICD-10 codes J40–J44, J47). Age in months was used as the time scale for all models starting at age of enrollment and ending at age of death, age of loss to follow-up, or age as of December 31, 2013, whichever came first. HRs associated with the 8 categories of smokers relative to never smokers were computed for each of the causes of death. We then analyzed the effects of mentholation (yes versus no) among current cigarette smokers adjusting for pack-years (continuous).

The following covariates were included in all models: race (black versus white), sex (female versus male), education (did not complete high school, completed some college, completed college or higher education versus completed high school), household income ($15 000–$24 999, $25 000–$49 999, ≥$50 000 versus <$15 000), recruitment source (CHC versus GP), and BMI (<20.0, 25.0–29.9, 30.0–34.9, 35.0–39.9, 40.0 or greater versus 20.0–24.9). We also included adjustment for histories of hypertension and diabetes when evaluating all-cause and CVD mortality, but little change was found in the smoking risk estimates and these adjustments were not pursued further.

We computed age-adjusted rates of mortality among never smokers by race and sex to aide in comparison of absolute (rather than relative) differences in risk between menthol and non-

menthol smokers and blacks and whites. All statistical tests were two-tailed with p-values <0.05 considered significant. Analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

Males were more likely to have smoked than females (76% and 54% respectively, p<0.0001). Among current and former smokers, menthol cigarette smoking was much more prevalent among blacks than whites (84% vs 27%, p<0.0001). The median (IQR, interquartile range) pack-years of cigarette smoking for current smokers of menthol and non-menthol cigarettes were 14.5 (7.6, 24.0) and 18.5 (10.2, 31.5), respectively, among blacks and 28.0 (15.5, 40.0) and 31.0 (18.5, 45.0) among whites. Menthol smokers reported smoking on average 1.1 and 1.7 fewer cigarettes per day than non-menthol smokers among blacks and whites, respectively. Among blacks, menthol smokers tended to be almost 5 years younger on average than non-menthol smokers while the difference among whites was less than 1 year. Table 1 presents demographic and lifestyle variables by race and sex for the 65 600 SCCS participants included in the analyses.

Participants were followed to ascertain vital status and cause of death for 8.1 years on average. Table 2 shows increased risks for CVD and heart disease mortality for all smoking categories compared to never smokers among both blacks and whites. In general, hazard ratios were higher for white than black smokers and, regardless of race, for smokers of non-menthol versus menthol cigarettes, with the differences most pronounced for current non-light (≥10 cpd) smokers. Associations between smoking and stroke were generally weaker than those observed for CVD, with no clear differences between menthol and non-menthol smokers. Supplemental Table 1 shows HRs and 95% CIs for cancer and COPD mortality according to the detailed smoking categories shown in Table 2 and documents the much higher HRs for lung cancer, and for all cancers combined (including lung cancer), than for CVD among all smoking categories.

Table 3 shows the HRs and 95% CIs for all-cause, CVD, heart disease and stroke mortality for menthol versus non-menthol cigarette use among current smokers. In analyses of both races combined, there was no difference in risk between menthol and non-menthol smokers for mortality from all causes (HR = 0.93, 95% CI = 0.86 to 1.01, p = 0.10), cardiovascular disease (HR = 0.88, 95% CI = 0.76 to 1.03, p = 0.10), heart disease (HR = 0.87, 95% CI = 0.73 to 1.04, p = 0.12), or stroke (HR = 1.07, 95% CI = 0.74 to 1.55, p = 0.72). For comparison, the table also shows that menthol smokers experienced lower mortality risks from all cancers (HR = 0.87, 95% CI = 0.75 to 1.00) and lung cancer (HR = 0.71, 95% CI = 0.57 to 0.88), but not COPD. Supplemental Table 2 presents demographic and lifestyle variables by race, sex, and cigarette type for the current smokers included in Table 3.

Discussion

This study provides evidence that menthol cigarette smoking is not associated with higher CVD (and all cause, heart disease or stroke) mortality risk than non-menthol cigarette smoking. We found no significant differences in risk of these diseases according to cigarette

mentholation status, with HRs comparing all-cause and CVD mortality among menthol vs non-menthol smokers slightly below rather than above 1.0. Although risk of stroke was reported to be elevated among menthol vs non-menthol cigarette smokers in a smaller cross-sectional study of current smokers from the National Health and Nutrition Examination Surveys (NHANES),[8] we found no association between menthol versus non-menthol cigarette smoking and stroke mortality risk. The excess was limited to women and to non-African Americans in the NHANES study, but we did not find significant increases in stroke mortality in either whites or women in the SCCS (the stroke HR among white women for menthol vs non-menthol use among current smokers was 0.70, although the 95% CI was a wide 0.20 to 2.47).

Lower intensity of smoking of menthol compared to non-menthol cigarettes, which has been reported in several studies,[11–16] was also observed in the SCCS. However, the slightly lower mortality risks among menthol smokers cannot be attributed to this difference because the analyses were stratified by smoking intensity or adjusted for pack-years of cigarette smoking. Quit rates are also unlikely to explain differences in mortality risks since previously published analyses in the SCCS reported equal odds of quitting among menthol and non-menthol smokers.[17] Although cotinine levels, measured in a small subset of SCCS participants, tended to be somewhat lower for menthol than non-menthol smokers, the adjusted differences were not significant.[18]

For these analyses, we were unable to identify participants who may have smoked both menthol and non-menthol cigarettes or to quantify the number of cigarettes smoked or length of time spent smoking either type since the SCCS questionnaire only asked about the type of cigarette usually smoked. Several studies have shown that prevalence of switching from menthol to non-menthol cigarettes or vice versa is low[19–21] and most participants who switch end up switching back.[17] Therefore, participants who may have switched between cigarette types are likely to have had a negligible effect on our results. Misclassification of cigarette type is possible but is likely minimal since adults appear to report cigarette type more accurately than adolescents and the percentages of menthol cigarette smokers found in this cohort (84% among blacks and 27% among whites) are nearly equivalent to those found in The National Survey on Drug Use and Health.[3,4] No information was available on the tar content of the cigarettes smoked so we were unable to compare this factor among menthol and non-menthol smokers.

The SCCS is a prospective cohort with large numbers of African Americans and whites of similarly low socioeconomic status and one of the nation’s major investigations into disparities in major chronic diseases. Smoking data were recorded at baseline and participants were followed to ascertain mortality experience using linkages believed to capture nearly all deaths among Americans.[22,23] African Americans account for approximately two-thirds of the cohort and a large majority of the African American smokers reported menthol cigarette use, making this the largest cohort of menthol smokers currently being traced. The design of this study provided us with the opportunity to produce precise estimates of the hazards of menthol cigarettes while minimizing the effects of socioeconomic status and recall bias. The results of this study add to the limited literature on disease risks associated with menthol cigarette use, and indicate that, similar to all-cause and

to cancer mortality, smokers of menthol cigarettes are not at increased risk of CVD compared to smokers of non-menthol cigarettes. This by no means indicates that menthols are safe or an appropriate alternative to non-menthol cigarette. Smoking of either type of cigarette substantially increases mortality overall as well as risk of death from CVD, with continuing efforts required to help smokers quit and prevent nonsmokers from adopting the habit.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors thank Carol Mayer for help with formatting the manuscript for publication.

Funding Sources

The Southern Community Cohort Study is supported by a grant from the National Cancer Institute at the NIH (R01 CA092447). The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

References

1. US Department of Health and Human Services. The First Conference on Menthol Cigarettes: Setting the Research Agenda, Executive Summary. Atlanta, Ga: US Department of Health and Human Services, National Institutes of Health, National Cancer Institute, Centers for Disease Control and Prevention; 2003.
2. Giovino GA, Sidney S, Gfroerer JC, O'Malley PM, Allen JA, Richter PA, Cummings KM. Epidemiology of menthol cigarette use. Nicotine Tob Res. 2004; 6(suppl 1):S67–S81. [PubMed: 14982710]
3. Substance Abuse and Mental Health Services Administration. The NSDUH Report: Use of Menthol Cigarettes. Rockville, Md: Substance Abuse and Mental Health Services Administration, Office of Applied Studies; 2009.
4. Substance Abuse and Mental Health Services Administration. The NSDUH Report: Recent Trends in Menthol Cigarette Use. Rockville, Md: Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality; 2011.
5. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, de Ferranti S, Després J-P, Fullerton HJ, Howard VJ, Huffman MD, Judd SE, Kissela BM, Lackland DT, Lichtman JH, Lisabeth LD, Liu S, Mackey RH, Matchar DB, McGuire DK, Mohler ER 3rd, Moy CS, Muntner P, Mussolino ME, Nasir K, Neumar RW, Nichol G, Palaniappan L, Pandey DK, Reeves MJ, Rodriguez CJ, Sorlie PD, Stein J, Towfighi A, Turan TN, Virani SS, Willey JZ, Woo D, Yeh RW, Turner MB. on behalf of the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics—2015 update: a report from the American Heart Association. Circulation. 2015; 131:e29–e322. [PubMed: 25520374]
6. Murray RP, Connett JE, Skeans MA, Tashkin DP. Menthol cigarettes and health risks in the Lung Health Study. Nicotine Tob Res. 2007; 9:101–107. [PubMed: 17365741]
7. Jones MR, Tellez-Plaza M, Navas-Acien A. Smoking, menthol cigarettes and all-cause, cancer and cardiovascular disease mortality: evidence from the National Health and Nutrition Examination Survey (NHANES) and a meta-analysis. PLoS ONE. 2013; 8:e77941. [PubMed: 24205038]
8. Vozoris NT. Mentholated cigarettes and cardiovascular and pulmonary diseases: a population-based study. Arch Intern Med. 2012; 172:590–591. [PubMed: 22493467]
9. Signorello LB, Hargreaves MK, Steinwandel MD, Zheng W, Cai Q, Schlundt DG, Buchowski MS, Arnold CW, McLaughlin JK, Blot WJ. Southern Community Cohort Study: establishing a cohort to investigate health disparities. J Natl Med Assoc. 2005; 97:972–979. [PubMed: 16080667]

10. Signorello LB, Hargreaves MK, Blot WJ. The Southern Community Cohort Study: investigating health disparities. J Health Care Poor Underserved. 2010; 21(1 Suppl):26–37. [PubMed: 20173283]
11. Stahre M, Okuyemi KS, Joseph AM, Fu SS. Racial/ethnic differences in menthol cigarette smoking, population quit ratios and utilization of evidence-based tobacco cessation treatments. Addiction. 2010; 105(suppl 1):75–83. [PubMed: 21059138]
12. Fagan P, Moolchan ET, Hart A, Rose A, Lawrence D, Shavers VL, Gibson JT. Nicotine dependence and quitting behaviors among menthol and non-menthol smokers with similar consumptive patterns. Addiction. 2010; 105(suppl 1):55–74. [PubMed: 21059137]
13. Muscat JE, Ritchie JP Jr, Stellman SD. Mentholated cigarettes and smoking habits in whites and blacks. Tob Control. 2002; 11:368–371. [PubMed: 12432163]
14. Hyland A, Garten S, Giovino GA, Cummings KM. Mentholated cigarettes and smoking cessation: findings from COMMIT. Tob Control. 2002; 11:135–139. [PubMed: 12035007]
15. Cubbin C, Soobader MJ, LeClere FB. The intersection of gender and race/ethnicity in smoking behaviors among menthol and non-menthol smokers in the United States. Addiction. 2010; 105(suppl 1):32–38. [PubMed: 21059134]
16. Curtin GM, Sulsky SI, Van Landingham C, Marano KM, Graves MJ, Ogden MW, Swauger JE. Primary measures of dependence among menthol compared to non-menthol cigarette smokers in the United States. Regul Toxicol Pharmacol. 2014; 69:451–466. [PubMed: 24852490]
17. Blot WJ, Cohen SS, Aldrich M, McLaughlin JK, Hargreaves MK, Signorello LB. Lung cancer risk among smokers of menthol cigarettes. J Natl Cancer Inst. 2011; 103:810–816. [PubMed: 21436064]
18. Signorello LB, Cai Q, Tarone RE, McLaughlin JK, Blot WJ. Racial differences in serum cotinine levels of smokers. Dis Markers. 2009; 27:187–192. [PubMed: 20037205]
19. Kasza KA, Hyland AJ, Bansal-Travers M, Vogl LM, Chen J, Evans SE, Fong GT, Cummings KM, O'Connor RJ. Switching between menthol and nonmenthol cigarettes: findings from the U.S. Cohort of the International Tobacco Control Four Country Survey. Nicotine Tob Res. 2014; 16:1255–1265. [PubMed: 24984878]
20. Rath JM, Villanti AC, Williams VF, Richardson A, Pearson JL, Vallone DM. Patterns of Longitudinal Transitions in Menthol Use Among U.S. Young Adult Smokers. Nicotine Tob Res. 2015; 17:839–846. [PubMed: 25480932]
21. Tauras JA, Levy D, Chaloupka FJ, Villanti A, Niaura RS, Vallone D, Abrams DB. Menthol and non-menthol smoking: the impact of prices and smoke-free air laws. Addiction. 2010; 105(suppl 1):115–123. [PubMed: 21059142]
22. Cowper DC, Kubal JD, Maynard C, Hynes DM. A primer and comparative review of major US mortality databases. Ann Epidemiol. 2002; 12:462–468. [PubMed: 12377423]
23. Wojcik MC, Huebner WW, Jorgensen G. Strategies for using the National Death Index and the Social Security Administration for death ascertainment in large occupational cohort mortality studies. Am J Epidemiol. 2010; 172(4):469–477. [PubMed: 20643697]

Table 1

Characteristics of the Southern Community Cohort Study participants by race and sex

Characteristic*	Overall, N (%) N=65 600	Blacks, N (%) Men N=19 551	Blacks, N (%) Women N=26 959	Whites, N (%) Men N=7333	Whites, N (%) Women N=11 757
Education					
< High School	18 767 (28.6)	6461 (33.0)	7971 (29.6)	1606 (21.9)	2729 (23.2)
High School	25 945 (39.6)	8134 (41.6)	10 588 (39.3)	2606 (35.5)	4617 (39.3)
Some College	12 759 (19.4)	3377 (17.3)	5506 (20.4)	1409 (19.2)	2467 (21.0)
≥ College	8129 (12.4)	1579 (8.1)	2894 (10.7)	1712 (23.3)	1944 (16.5)
Smoking status, type, cpd†					
Never smoker	24 176 (36.9)	4391 (22.5)	13 132 (48.7)	1946 (26.5)	4707 (40.0)
Former, non-menthol	5238 (8.0)	823 (4.2)	949 (3.5)	1692 (23.1)	1774 (15.1)
Former, menthol	8567 (13.1)	2906 (14.9)	4070 (15.1)	499 (6.8)	1092 (9.3)
Current, non-menthol, < 10	1580 (2.4)	489 (2.5)	463 (1.7)	218 (3.0)	410 (3.5)
Current, non-menthol, 10–19	2502 (3.8)	607 (3.1)	371 (1.4)	607 (8.3)	917 (7.8)
Current, non-menthol, ≥ 20	4295 (6.5)	505 (2.6)	316 (1.2)	1771 (24.2)	1703 (14.5)
Current, menthol, < 10	7294 (11.1)	3645 (18.6)	3353 (12.4)	86 (1.2)	210 (1.8)
Current, menthol, 10–19	6704 (10.2)	3592 (18.4)	2632 (9.8)	134 (1.8)	346 (2.9)
Current, menthol, ≥ 20	5244 (8.0)	2593 (13.3)	1673 (6.2)	380 (5.2)	598 (5.1)
Income					
< $15 000	36 456 (55.6)	11 791 (60.3)	15 837 (58.7)	3154 (43.0)	5674 (48.3)
$15 000–$24 999	14 212 (21.7)	4223 (21.6)	6378 (23.7)	1258 (17.2)	2353 (20.0)
$25 000–$49 999	9046 (13.8)	2418 (12.4)	3445 (12.8)	1237 (16.9)	1946 (16.6)
≥ $50 000	5886 (9.0)	1119 (5.7)	1299 (4.8)	1684 (23.0)	1784 (15.2)
Body Mass Index (kg/m^2)					
< 20	2424 (3.7)	871 (4.5)	776 (2.9)	245 (3.3)	532 (4.5)
20–24.9	14 789 (22.5)	6380 (32.6)	3792 (14.1)	1966 (26.8)	2651 (22.5)
25–29.9	19 492 (29.7)	6834 (35.0)	6856 (25.4)	2713 (37.0)	3089 (26.3)
30–34.9	14 026 (21.4)	3403 (17.4)	6653 (24.7)	1451 (19.8)	2519 (21.4)
35–39.9	7743 (11.8)	1324 (6.8)	4398 (16.3)	565 (7.7)	1456 (12.4)
≥ 40	7126 (10.9)	739 (3.8)	4484 (16.6)	393 (5.4)	1510 (12.8)

Characteristic*	Overall, N (%) N=65 600	Blacks, N (%) Men N=19 551	Blacks, N (%) Women N=26 959	Whites, N (%) Men N=7333	Whites, N (%) Women N=11 757
Enrollment Source					
CHC	58 619 (89.4)	18 336 (93.8)	25 171 (93.4)	5288 (72.1)	9824 (83.6)
GP	6981 (10.6)	1215 (6.2)	1788 (6.6)	2045 (27.9)	1933 (16.4)
Enrollment Age, Mean (SD)	51.5 (8.5)	50.2 (7.7)	51.4 (8.7)	52.7 (8.7)	53.2 (8.9)
Pack-years,‡ Median (IQR)	17.5 (9.3, 31.0)	16.0 (8.8, 27.0)	13.5 (6.9, 23.0)	33.0 (20.8, 48.0)	28.0 (16.0, 40.5)

N, number; %, percentage; cpd, cigarettes per day; kg/m^2, kilogram per square meters; CHC, Community Health Center; GP, General Population; SD, standard deviation; IQR, interquartile range.

P < 0.0001 for all chi-square tests, analysis of variance F test, and Kruskal-Wallis test.

*Recorded at entry into the cohort.

†Smoking status, type of cigarette usually smoked, and average number of cigarettes smoked per day self-reported at entry into the cohort.

‡Pack-years among current smokers

Table 2

Mortality from all causes, cardiovascular disease, heart disease, and stroke for menthol and non-menthol cigarette smokers

Smoking status, type, cpd*	Overall HR (95% CI) †	Blacks HR (95% CI) †	Whites HR (95% CI) †
All causes (N=7689)			
Never smoker‡	1.00	1.00	1.00
Former, non-menthol	1.21 (1.11, 1.33)	1.19 (1.04, 1.35)	1.33 (1.15, 1.53)
Former, menthol	1.30 (1.20, 1.40)	1.26 (1.15, 1.37)	1.40 (1.16, 1.68)
Current, non-menthol, < 10	1.78 (1.56, 2.03)	1.58 (1.34, 1.86)	2.24 (1.78, 2.82)
Current, non-menthol, 10–19	**2.22 (2.00, 2.47)**	**1.99 (1.72, 2.32)**	2.65 (2.25, 3.12)
Current, non-menthol, ≥ 20	**2.24 (2.04, 2.45)**	1.96 (1.67, 2.31)	2.58 (2.25, 2.95)
Current, menthol, < 10	1.64 (1.51, 1.79)	1.57 (1.43, 1.71)	2.54 (1.86, 3.47)
Current, menthol, 10–19	**1.78 (1.63, 1.93)**	**1.70 (1.55, 1.87)**	2.25 (1.72, 2.94)
Current, menthol, ≥ 20	**1.91 (1.75, 2.08)**	1.79 (1.62, 1.97)	2.46 (2.03, 2.98)
Cardiovascular disease§ (N=2289)			
Never smoker‡	1.00	1.00	1.00
Former, non-menthol	1.04 (0.88, 1.23)	0.98 (0.78, 1.23)	1.18 (0.91, 1.53)
Former, menthol	1.11 (0.97, 1.27)	1.08 (0.93, 1.25)	1.29 (0.91, 1.81)
Current, non-menthol, < 10	1.48 (1.15, 1.89)	1.48 (1.12, 1.97)	1.46 (0.88, 2.44)
Current, non-menthol, 10–19	1.81 (1.48, 2.22)	1.68 (1.28, 2.21)	2.13 (1.54, 2.94)
Current, non-menthol, ≥ 20	**1.91 (1.61, 2.27)**	**2.05 (1.56, 2.68)**	2.06 (1.59, 2.67)
Current, menthol, < 10	1.38 (1.18, 1.60)	1.33 (1.14, 1.56)	1.78 (0.90, 3.51)
Current, menthol, 10–19	1.45 (1.24, 1.69)	1.40 (1.19, 1.65)	1.90 (1.11, 3.27)
Current, menthol, ≥ 20	**1.46 (1.23, 1.72)**	**1.29 (1.07, 1.56)**	2.50 (1.75, 3.56)
Heart disease‖ (N=1687)			
Never smoker‡	1.00	1.00	1.00
Former, non-menthol	1.04 (0.85, 1.26)	1.07 (0.82, 1.40)	1.04 (0.77, 1.40)
Former, menthol	1.22 (1.04, 1.43)	1.19 (1.00, 1.42)	1.36 (0.94, 1.96)
Current, non-menthol, < 10	1.58 (1.19, 2.10)	1.59 (1.13, 2.22)	1.58 (0.91, 2.73)
Current, non-menthol, 10–19	1.79 (1.41, 2.27)	1.62 (1.15, 2.26)	2.07 (1.44, 2.96)
Current, non-menthol, ≥ 20	**2.02 (1.65, 2.46)**	**2.32 (1.71, 3.16)**	2.04 (1.53, 2.72)
Current, menthol, < 10	1.34 (1.12, 1.61)	1.29 (1.06, 1.56)	2.18 (1.10, 4.34)
Current, menthol, 10–19	1.50 (1.25, 1.80)	1.45 (1.19, 1.77)	1.89 (1.03, 3.46)
Current, menthol, ≥ 20	**1.55 (1.27, 1.87)**	**1.39 (1.12, 1.74)**	2.34 (1.57, 3.49)
Stroke# (N=389)			
Never smoker‡	1.00	1.00	1.00
Former, non-menthol	0.95 (0.63, 1.44)	0.76 (0.43, 1.34)	1.32 (0.67, 2.59)
Former, menthol	0.79 (0.55, 1.14)	0.81 (0.55, 1.19)	0.63 (0.19, 2.14)
Current, non-menthol, < 10	0.75 (0.35, 1.61)	0.94 (0.44, 2.04)	Not estimable**
Current, non-menthol, 10–19	1.94 (1.22, 3.08)	2.01 (1.13, 3.57)	1.88 (0.81, 4.34)

Smoking status, type, cpd*	**Overall HR (95% CI) †**	**Blacks HR (95% CI) †**	**Whites HR (95% CI) †**
Current, non-menthol, ≥ 20	1.45 (0.91, 2.31)	1.22 (0.56, 2.65)	1.55 (0.76, 3.14)
Current, menthol, < 10	1.53 (1.09, 2.14)	1.59 (1.13, 2.26)	Not estimable **
Current, menthol, 10–19	1.50 (1.05, 2.14)	1.53 (1.05, 2.22)	2.13 (0.61, 7.42)
Current, menthol, ≥ 20	1.31 (0.87, 1.97)	1.25 (0.80, 1.96)	2.11 (0.81, 5.49)

cpd, cigarettes per day; HR, hazard ratio; CI, confidence interval; ICD, International Classification of Diseases.

Results in bold indicate a significant difference comparing non-menthol and menthol cigarettes within a smoking status/cpd category.

* Smoking status, type of cigarette usually smoked, and average number of cigarettes smoked per day self-reported at entry into the cohort.

† HRs and 95% CIs from Cox proportional hazards models adjusted for race (black, white), sex, enrollment source (community health centers, general population), education (<12, 12 years, some college, college or beyond), income (<$15 000, $15 000–$24 999, $25 000–$49 999, ≥$50 000), and body mass index (<20.0, 20.0–24.9, 25.0–29.9, 30.0–34.9, 35.0–39.9, ≥40.0) with age used as the time scale.

‡ Age-adjusted annual mortality rates per 1000 among never smokers were 14.36 for blacks and 12.96 for whites for all deaths, 5.33 for blacks and 4.87 for whites for CVD, 3.73 for blacks and 4.36 for whites for heart disease, and 1.14 for blacks and 0.42 for whites for stroke.

§ ICD-10: I00–I78

‖ ICD-10: I00–I09, I11, I13, I20–I51

ICD-10: I60–I69

** No white participants in this smoking category died from a stroke.

Table 3

All-cause and cause-specific mortality for menthol versus non-menthol cigarette smoking among current smokers *

Cause of death †	Overall HR (95% CI) ‡	Blacks HR (95% CI) ‡	Whites HR (95% CI) ‡
All causes (N=4224)	0.93 (0.86, 1.01)	0.96 (0.87, 1.06)	0.94 (0.82, 1.08)
Cardiovascular disease (N=1130)	0.88 (0.76, 1.03)	0.84 (0.70, 1.00)	1.09 (0.82, 1.43)
Heart disease (N=829)	0.87 (0.73, 1.04)	0.83 (0.67, 1.02)	1.06 (0.78, 1.44)
Stroke (N=198)	1.07 (0.74, 1.55)	1.05 (0.69, 1.60)	1.24 (0.57, 2.67)
Cancer (N=1142)	0.87 (0.75, 1.00)	0.90 (0.76, 1.07)	0.82 (0.61, 1.10)
Lung cancer (N=497)	0.71 (0.57, 0.88)	0.74 (0.57, 0.95)	0.68 (0.43, 1.07)
Cancer except lung cancer (N=645)	1.02 (0.83, 1.25)	1.06 (0.83, 1.35)	0.95 (0.64, 1.40)
Non-asthma COPD (N=195)	0.99 (0.70, 1.40)	1.27 (0.73, 2.20)	0.89 (0.55, 1.44)

HR, hazard ratio; CI, confidence interval; ICD, International Classification of Diseases; COPD, chronic obstructive pulmonary disease.

* Self-reported smoking status and type of cigarette usually smoked at entry into the cohort.

† ICD-10 codes: cardiovascular disease (I00–I78), heart disease (I00–I09, I11, I13, I20–I51), stroke (I60–I69), cancer (C00–C97), lung cancer (C34), cancer except lung cancer (C00–C33, C35–C97), and non-asthma COPD (J40–J44, J47).

‡ HRs and 95% CIs from Cox proportional hazards models adjusted for race (black, white), sex, enrollment source (community health centers, general population), education (<12, 12 years, some college, college or beyond), income (<$15 000, $15 000–$24 999, $25 000–$49 999, ≥$50 000), body mass index (<20.0, 20.0–24.9, 25.0–29.9, 30.0–34.9, 35.0–39.9, ≥40.0), and pack-years of cigarette smoking (continuous) with age used as the time scale.